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SHORT NOTES

Revision of an Ordovician cephalopod *Ormoceras yokoyamai* (Kobayashi, 1927)

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Introduction

Systematic position of an Ordovician cephalopod *Ormoceras yokoyamai* (Kobayashi, 1927) is reconsidered on the basis of type specimens kept in the University Museum of the University of Tokyo (prefixed UMUT) and the new material from the type stratum Jigunsan Formation, Choson Supergroup in Gangwon-Do, South Korea. The Jigunsan Formation, named by Yamanari (1926), is a relatively thin (45-100 m in thickness) fossiliferous sequence of interbeded shale and subordinate limestone. On the basis of studies primarily of trilobites and cephalopods, Kobayashi (1966) assigns the principal part of the formation to Llanvirn (upper Middle Ordovician). This correlation is in agreement with conodont biochronology by Lee (1977, 1980). The newly collected specimens come from float blocks of shale at (1) locality G90075, latitude 37° 10′ 39.5″ N, longitude 128° 42′ 7.1″ E, in a field on the southwestern slope of Mt. Jigun, Jikdongri, Jungdong-myeon, Yeongwol-gun (UMUT PM 27827), and (2) locality J89105, latitude 37° 5′ 42.4″ N, longitude 129° 0′ 52.6″ E, on the northern flank of a small tributary of the Hwangji River in Jangseong, Taebaek-city (UMUT PM 27828).

Systematic paleontology

? Subclass Actinoceratoidea Teichert, 1933
? Order Actinocerida Teichert, 1933
Family Proteoceratidae Flower, 1962
Genus ***Treptoceras*** Flower, 1942

Type species.—*Orthoceras duseri* Hall and Whitfield, 1875.

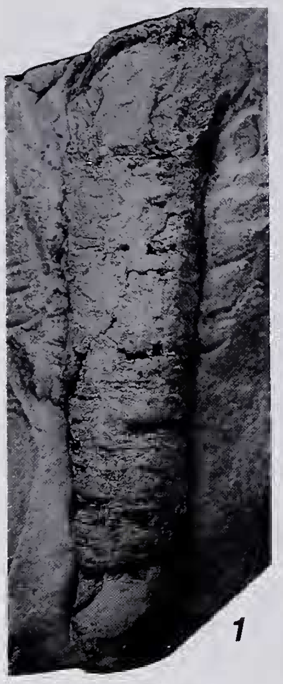
Treptoceras yokoyamai (Kobayashi, 1927)

Figure 1

Loxoceras yokoyamai Kobayashi, 1927, p. 186, 187, pl. 18, figs. 9a-c.
Sactoceras yokoyamai (Kobayashi). Kobayashi, 1934, p. 439, 440, pl. 27, figs. 1-6, pl. 28, fig. 2.
Ormoceras yokoyamai (Kobayashi). Yun, 1999, p. 214.

Emended diagnosis.—Small species of *Treptoceras* with low angle (approximately 5°) of shell expansion, oval cross section with form ratio (lateral/dorsoventral diameter) 1.2-1.5; siphuncle submarginal with siphuncular position ratio (minimum distance of central axis of siphuncle from shell wall per dorsoventral shell diameter) approximately 0.2 in adoral shell; septal necks cyrtochoanitic to suborthochoanitic; cameral deposits weak for genus.

Description.—Small-sized orthocones for genus with gradual shell expansion indicating approximately 5° in dorsoventral plane (Figure 1.1); apical shell may be curved on the basis of a specimen (UMUT PM 0686 figured by Kobayashi, 1934, pl. 27, fig. 6); details of shell surface not observed in all examined specimens, but annulations and conspicuous ornamentation not detected; cross section of shell dorsoventrally depressed, oval with form ratio of 1.2-1.5 (Figure 1.2); largest known specimen (UMUT PM 0685 figured by Kobayashi, 1934, pl. 27, figs. 3-5) attains 11.0 mm in dorsoventral diameter and 15.5 mm in lateral diameter, whose adoral part represents apical body chamber; sutures transverse to slightly oblique, nearly straight or weakly sinuate to form very shallow ventral and dorsal lobes in rare cases (Figure 1.1); camerae very short, giving width/length ratios which ranges from 4.6 to 10.9+, with shallow septal curvature (Figure 1.3); no septal furrow detected; adoral siphuncle stenosiphonate and submarginal in position, with siphuncular position ratio approximately 0.2 (Figure 1.3); septal necks cyrtochoanitic to suborthochoanitic, not recumbent (Figure 1.4-1.7); well-preserved dorsal septal neck attains 0.27 mm in length at dorsoventral shell diameter of approximately 7 mm; adnation area usually



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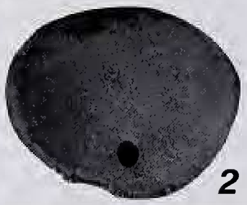

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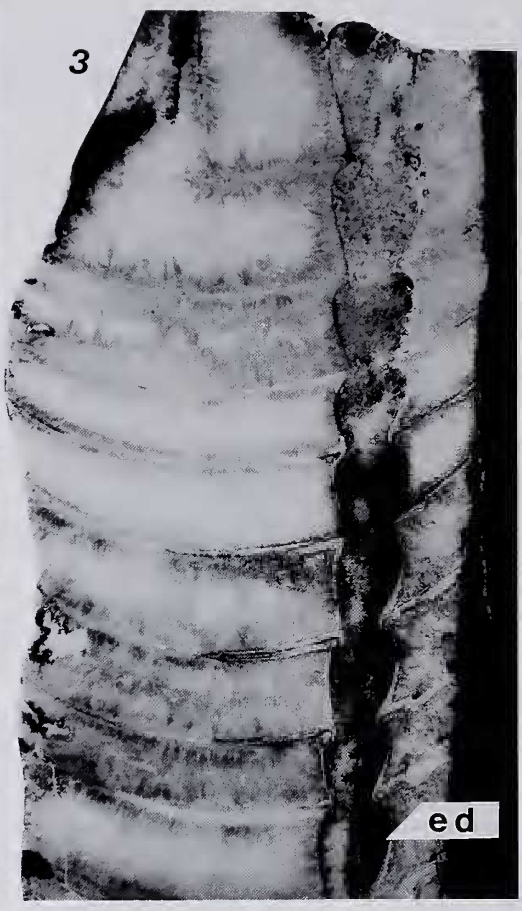

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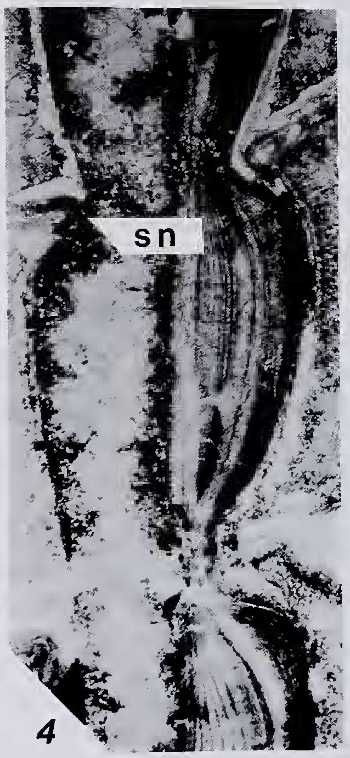

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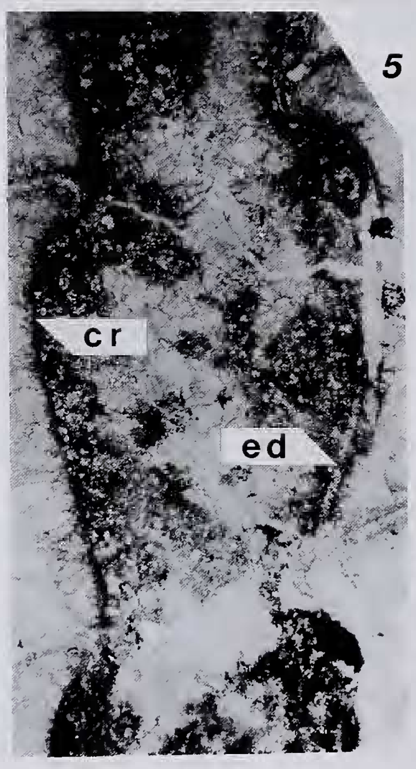

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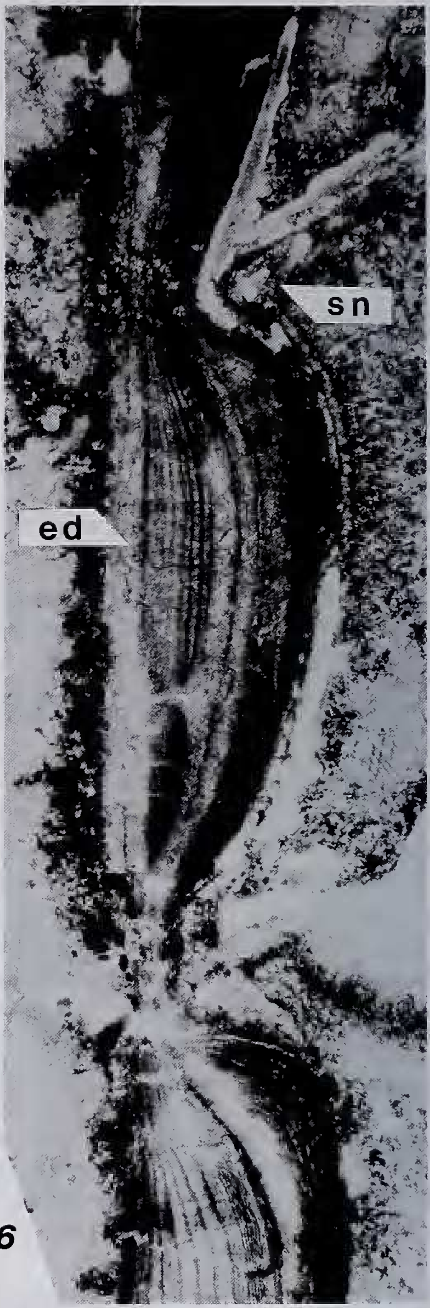

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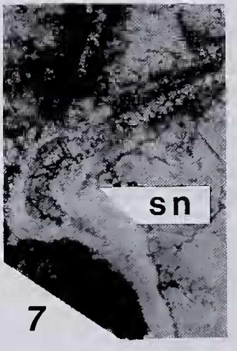

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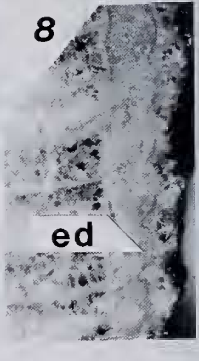

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absent; connecting rings relatively thick, 0.05–0.07 mm, and undifferentiated (Figure 1.5), forming subglobular profile in apical dorsoventral section of a specimen (UMUT PM 0686) with maximum diameter/length ratio of siphuncular segments approximately 1.3, inflation then rapidly decreases, creating fusiform to pyriform (and subglobular in rare cases) profile in adoral dorsoventral section with ditto ratio 0.6–0.9 (Figure 1.4, 1.5); curvature of septal brims and inflation of connecting rings are slightly stronger on ventral siphuncular side than on dorsal one (Figure 1.4, 1.5); cameral deposits weak for genus, restricted in apical camerae, composed of thin episeptal-mural and hyposeptal deposits (Figure 1.3). Endosiphuncular deposits are also restricted to apical siphuncle (Figure 1.3); laminated parietal deposits to form thick lining on ventral siphuncular wall (Figure 1.4, 1.6); thickness of ventral lining decreases at septal foramen and its surface usually linear in profile in longitudinal section (Figure 1.4, 1.6); parietal deposits rarely developed on dorsal connecting rings, which interrupted at septal foramen (Figure 1.4); canal system and perispatium not developed.

Discussion.— Morphologically, the most diagnostic feature of this species is the structure of the endosiphuncular deposits that is observable in Kobayashi's specimen UMUT PM 0687 (Figure 1.8), and a section from the new material, UMUT PM 27827 (Figure 1.3–1.6). Its combination of the characteristic parietal deposits that form the ventral lining and lack of a canal system (Figure 1.4, 1.6) confirm systematic placement of the species in the Proteoceratidae rather than the Pseudactinoceratidae (*Loxoceras* M'Coy, 1844; Doguzhaeva and Shkolin, 1999) or the Ormoceratidae (*Ormoceras* Stokes, 1840 and its subjective junior synonym *Sactoceras* Hyatt, 1884). In addition, the species does not exhibit an exogastric cyrtocone, surface annulations and strongly bulging sutural elements, which features are diagnostic only for two closely related genera, i.e., *Treptoceras* (some emendations to the generic diagnosis were added by Aronoff, 1979, and Frey, 1988) and *Proteoceras* (Flower, 1955; type species *Ooceras*(?) *perkinsi* Ruedemann, 1906). These genera can be distinguished by the degree of the siphuncular changes which are less drastic in *Treptoceras duseri* and the present Korean species (Figure 1.3) than in *Proteoceras perkinsi*. The siphuncular segments of *Proteoceras* shift from a subglobular form to a nearly cylindrical one in the space of 6–8 camerae. Accordingly, *Ormoceras yokoyamai* is attributed to *Treptoceras*.

Although confident determination of the proteoceratid's higher taxonomic position is pending until the apical shell form is clarified, it is herein proposed that a possible origin of the Proteoceratidae was derived from the subclass Actinocerida. Flower (1962) placed the Proteoceratidae in the order Orthocerida of the subclass Nautiloidea, and his assertion was followed in the Treatise (Sweet, 1964) and by Aronoff (1979) and Frey (1988). However, the rapid decrease of the siphuncular inflation of *Proteoceras perkinsi*, *Treptoceras duseri*, and *T. yokoyamai* is exceedingly unusual for the subclass Nautiloidea, and it seems rather suggestive of a phylogenetic relationship with some actinocerids including *Paractinoceras* (Hyatt *in* Zittel, 1900), *Leurorthoceras* (Foerste, 1921) and *Kobayashiceras* (Niko, 1998). Endosiphuncular lining deposits lacking radial canal and perispatium are also known in the adoral siphuncle of *Kobayashiceras*. This indicates that presence or absence of the canal system in the adoral shell is not always essential for Actinoceratoidea.

Material examined.—The holotype, UMUT PM 0016. The five specimens, UMUT PM 0683–0687, also identified as this species by Kobayashi (1934). In addition, the two new specimens of the imperfect phragmocones of UMUT PM 27827, 44.8 mm in length, and UMUT PM 27828, approximately 31 mm in length, have been examined.

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← **Figure 1.** *Treptoceras yokoyamai* (Kobayashi). **1**, **3**–**7**, UMUT PM 27827. **1**, dorsal view, × 2; **3**, dorsoventral thin section, venter on right, × 8; **4**, details of apical siphuncle, × 30; **5**, details of adoral siphuncle, × 30; **6**, details of endosiphuncular deposits, × 50; **7**, details of adoral septal neck, × 50. **2**. UMUT PM 27828, septal view of adoral end, venter down, silicon rubber replica, × 4. **8**. UMUT PM 0687, dorsoventral polished section, venter on right, × 5.5. Abbreviations: **cr**, connecting ring; **ed**, endosiphuncular deposits; **sn**, septal neck.

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